

A P P E N D I X AS P E C I A L I N S T R U C T I O N S

## MANUFACTURING AND PRODUCTION TESTS:

## FIELD REPRESENTATIVE:

## GENERAL

This Appendix contains information describing the manufacturer's test equipment and his responsibilities for all units except those outlined in page 9. This appendix outlines production line testing required for units that comply with the "Utility Interactive Inverter" requirements per The Standard For Inverters, Converters and Controllers For Use In Independent Power Systems, UL 1741.

## INSTRUCTIONS FOR TESTS AND/OR INSPECTION AT THE FACTORY

During the regular visits to the factory:

- A. Verify that the manufacturer has the required test equipment. See Pages 2, 3, and 6.
- B. Verify that the equipment is functioning properly and all the instruments have been calibrated at least once annually.
- C. Observe that the manufacturer is performing the dielectric voltage withstand test and the utility voltage and frequency variation test on 100 percent of production.
- D. Each unit tested in the production line shall be marked with an ID marking and recorded in the production records. Test records shall be maintained in a log on 100 percent of the production units with results. Review of the manufacturer's records to assure that the tests are being conducted and appropriate action is taken with respect to failures and rejections is to be during each inspection.

RESPONSIBILITY OF THE MANUFACTURER

- 1. 100 percent of production of each unit covered by the end-product Procedure shall be subjected to the dielectric voltage withstand test.
- 2. 100 percent of production of each utility interactive inverter shall be subjected to the Utility Voltage and Frequency Variation Test.
- 3. During the period of production, test equipment shall be checked for proper operation at least once daily.

4. The instruments used for the required tests shall be calibrated at regular intervals (at least once annually). Calibration may be done by the manufacturer or an outside laboratory. In either case, it shall be by comparison with a standard that is traceable to a national standard. Certification of this calibration shall be maintained by the manufacturer.
6. The manufacturer shall maintain instrument calibration records. All records shall be readily available to UL personnel.
7. The manufacturer shall keep a production record of all units tested according to their ID marking with results as specified above in item D. All records shall be readily available to UL personnel.

I. MANUFACTURER'S TEST EQUIPMENT:

DIELECTRIC VOLTAGE WITHSTAND TEST EQUIPMENT

1. The test equipment shall have (1) a means of indicating the test potential, (2) an audible or visual indicator of electrical breakdown, and, (3) for automated or station type operations, either a manual reset device to restore the equipment after electrical breakdown, or an automatic-reject feature for any unacceptable units. When an alternating current test potential is applied, the test equipment shall include a transformer having an essentially sinusoidal output.

2. When the rated output of the test equipment is less than 500 VA, the equipment shall include a voltmeter in the output circuit to directly indicate the applied test potential.

3. When the rated output of the test equipment is 500 VA or more, the test potential may be indicated by either (1) a voltmeter in the primary circuit or in a tertiary-winding circuit, (2) a selector switch marked to indicate the test potential, or (3) in the case of equipment having a single test potential output, by a marking in a readily visible location to indicate the test potential. If an indicating voltmeter is not used the test equipment shall include a visual means, such as an indicator lamp, to indicate that the test potential is present at the test equipment output.

4. Test equipment other than that described by Pars. 1 through 3 may be used if found acceptable to accomplish the intended factory control required by UL.

MANUFACTURER'S DIELECTRIC VOLTAGE WITHSTAND TEST EQUIPMENT:

The equipment specified below has been examined and found to be acceptable for use by this manufacturer in conducting the production-line dielectric voltage withstand test:

Manufacturer  
*QUADTECH*

Part No.  
*CENTRY 30*

UTILITY VOLTAGE AND FREQUENCY VARIATION TEST EQUIPMENT

This test shall be conducted by using the outlined equipment below.

Any suitable measurement devices may be used to determine compliance with the requirements. The measurement devices may include but are not limited to variable voltage and frequency power supplies, oscilloscopes, voltmeters and frequency meters. All measurement equipment must be calibrated on an annual basis or sooner if designated by the equipment manufacturer.

The equipment specified below has been examined and found to be acceptable for use by this manufacturer in conducting the utility voltage and frequency variation test:

Manufacturer

*ELGAR*

Part No.

*SW 5250A*

## II. PRODUCTION TESTS TO BE CONDUCTED:

### DIELECTRIC VOLTAGE-WITHSTAND TEST

1. Each appliance shall withstand without electrical breakdown, as a routine production-line test, the application of an AC potential at a frequency within the range of 40-70 Hz, or a DC potential, between the primary wiring, including connected components and the (a) accessible dead-metal parts that are likely to become energized, and (b) accessible low voltage (42.4 V peak, 60 V dc or less) connectors.

#### Method

The test duration and potential shall be as described in either Condition A or B below.

Unit Voltage Rating, V	Condition A			Condition B		
	Test Potential, V ac	Test Potential, V dc	Time, s	Test Potential, V ac	Test Potential, V dc	Time, s
250 or less	1000	1400	60	1200	1700	1
More than 250	1000+2V <sup>a</sup>	1400+2.8V <sup>a</sup>	60	1200+2.4V <sup>a</sup>	1700+3.4V <sup>a</sup>	1

a - Maximum marked voltage.

2. The test potential may be gradually increased to the required value but the full value is to be maintained for 1 s or 1 min. as required.

3. The unit can be at intended operating temperature, at room temperature, or at any intermediate temperature, for the test.

4. During the test all primary circuit conductors of the unit shall be connected together to one terminal of the test equipment. The second test equipment terminal shall be connected to the accessible dead-metal.

5.

4. During the test all primary circuit conductors of the unit shall be connected together to one terminal of the test equipment. The second test equipment terminal shall be connected to all secondary circuits.

5. The test shall be conducted when the unit is fully assembled. It is not intended that the unit be unwired, modified, or disassembled for the test.

Exception No. 1: Parts such as snap covers or friction-fit knobs that interfere with performance of the test need not be in place.

Exception No. 2: The test can be performed before final assembly if the test represents that for the completed unit. Any component not included shall not affect the results with respect to determination of possible electric shock from miswiring, defective component, unacceptable spacings, and the like.

Exception No. 3: Solid state components that might be damaged by a secondary effect (induced voltage surge, excessive heating, and the like) of the test may be short-circuited by means of a temporary electrical jumper, or the test may be conducted without the component electrically connected, provided the wiring and terminal spacings are maintained. Additionally, transient voltage suppression devices other than capacitors connected from primary wiring to dead metal, may be disconnected during the test.

6. For the test, either a sufficient number of control devices are to be closed or separate applications of the test potential shall be made so that all parts of the primary circuit are tested.

VOLTAGE AND FREQUENCY VARIATION TEST

As a routine production line test, each utility interactive inverter shall cease to export power to the simulated utility source within the time specified below for each test condition after the output voltage and frequency of the utility source and adjusted to each condition specified below. Note that each condition in A-D shall be performed on any individual phase( A, B or C). Each test outlined below is to be conducted once on each model.

Condition	Simulated utility source		Maximum time, sec(cycles) at 60Hz before cessation of current to the Simulated utility
	Voltage, V	Frequency	
A	331	rated	0.1 (6)
B	417	rated	2 (120)
C	532	rated	2 (120)
D	540	rated	0.33 (2)
E	rated	$f > \text{rated} + 0.5$	0.1 (6)
F	rated	$f < \text{rated} - 0.7$	0.1 (6)

Please see under each condition A-F described below for test method.

Condition A

Fast Undervoltage Test: The default setting in the software of the inverter is set to test this protective relay function at a voltage of 340 V L-L. The simulated utility source equipment will be set to step the voltage on only one phase from 480 V L-L to 331 V L-L in a time of 1 cycle. This voltage is then to be held constant for 6 cycles before being stepped back up to 480 V L-L. The inverter will be verified as having complied with the this requirement if it trips due to this 6 cycle stimulus.

Condition B

Undervoltage Test: The default setting in the software of the inverter is to be 428 V L-L, with a delay time of 1.95 seconds. The simulated utility source equipment will be set to step the voltage of only one phase from 480 V L-L to 417 V L-L in a time of 1 cycle. This voltage will then be held constant for 2 seconds before being stepped back down to 480 V L-L. The inverter will be verified as having complied with this requirement if it trips due to this 2 second stimulus.

Condition C

Overvoltage Test: The default setting in the software of the inverter will be 524 V L-L, with a delay time of 1.95 seconds. The simulated utility source equipment will be set to step the voltage of only one phase from 480 V L-L to 532 V L-L in a time of 1 cycle. This voltage will then be held constant for 2 seconds before being stepped back down to 480 V L-L. The inverter will be verified as having complied with this requirement if it trips due to this 2 second stimulus.

VOLTAGE AND FREQUENCY VARIATION TEST( Continued)Condition D

Fast Overvoltage Test: The default setting in the inverter software is set to test this protective relay function at a voltage of 532 V L-L. The simulated utility source equipment will be set to step the voltage on only one phase from 480 V L-L to 540 V L-L in a time of 1 cycle. This voltage will then be held for constant 2 cycles before being stepped back down to 480 V L-L. The inverter will be verified as having complied with this requirement if it trips due to this 2 cycle stimulus.

Condition E

Overfrequency Test #1: The default setting of the inverter software will be 60.5 Hz. The simulated utility source equipment will be set to ramp the frequency from 60.0 Hz to 60.4 Hz in a time of 2 seconds and then to step the frequency from 60.4 Hz to 60.6 Hz in a time of 1 cycle. This frequency is to then be held constant for 9 cycles before being stepped back down to 60.0 Hz.

Overfrequency Test #2: The default setting of the inverter software will be 60.5 Hz. The simulated utility source equipment will be set to ramp the frequency from 60.0 Hz to 60.4 Hz in a time of 2 seconds and then to step the frequency from 60.4 Hz to 60.9 Hz in a time of 1 cycle. This frequency is to then be held constant for 6 cycles before being stepped back down to 60.0 Hz.

Condition F

Underfrequency Test #1: The default setting of the inverter software will be 59.3 Hz. The simulated utility source equipment will be set to ramp the frequency from 60.0 Hz to 59.4 Hz in a time of 2 seconds and then to step the frequency from 59.4 Hz to 59.2 Hz in a time of 1 cycle. This frequency is then to be held constant for 9 cycles before being stepped back up to 60.0 Hz. The inverter will be verified as having complied with this requirement if it trips due to this 9 cycle stimulus.

Underfrequency Test #2: The default setting of the inverter software will be 59.3 Hz. The simulated utility source equipment will be set to ramp the frequency from 60.0 Hz to 59.4 Hz in a time of 2 seconds and then to step the frequency from 59.4 Hz to 58.9 Hz in a time of 1 cycle. This frequency is then be held constant for 6 cycles before being stepped back up to 60.0 Hz. The inverter will be verified as having complied with this requirement if it trips due to this 6 cycle stimulus.

Each verification test may be conducted without full rated power.



DIELECTRIC WITHSTAND TEST

General - Based on engineering judgment, the production-line dielectric voltage withstand test is not required to be performed on the models tabulated below:

<u>Product</u>	<u>Model Designation</u>	<u>Procedure</u> <u>Vol. Section</u>
	None	

UTILITY VOLTAGE AND FREQUENCY VARIATION TEST

General - Based on engineering judgment, the utility voltage and frequency variation test is not required to be performed on the models tabulated below:

<u>Product</u>	<u>Model Designation</u>	<u>Procedure</u> <u>Section</u>
	None	